CLAIMS

1. An electromagnetic simulation algorithm, for determining the electromagnetic wave scattered by a body in a monofrequency situation, from a meshing of said body and from the electromagnetic excitation,
characterized in that it comprises at least:

   (a) a determination of a matrix M, the so-called interaction matrix, whose coefficients are determined from the meshing of said body;

   (b) a determination of a preconditioner Z of the matrix M, this preconditioner being the matrix formulation of the operator $\mathcal{J}^* \mathcal{M} \mathcal{J}$, where $\mathcal{M}$ is the operator associated with M, $\mathcal{J}$ the operator vector product with the normal to the surface of said body and $\mathcal{J}^*$ the operator adjoined to $\mathcal{J}$;

   (b) a determination of the currents which flow around the surface of said body, through an iterative algorithm of conjugate gradient type using said preconditioner Z, the iterative algorithm making it possible to solve an equation, the so-called boundary integral equation of electromagnetism, written in matrix form in the following manner:

$$MU = L$$

   where U is a vector which we seek to determine, whose coefficients represent the surface currents, and L is a known vector, whose coefficients represent the electromagnetic excitation;

   (c) a determination of the wave scattered by said body, from said surface currents.

2. The electromagnetic simulation algorithm as claimed in claim 1, characterized in that the

coefficients of the vector U are expressed in the usual basis of the Raviart-Thomas space.

3. The electromagnetic simulation algorithm as claimed in one of the preceding claims, characterized in that the preconditioner Z is determined implicitly

4. The electromagnetic simulation algorithm as claimed in one of the preceding claims, characterized in that the preconditioner Z is defined by the following relation:

$$Z = {}^{t}JMJ$$

where J is a matrix formulation of the operator $\mathcal{J}$, and ${}^{t}J$ the transposed matrix of J.

5. The electromagnetic simulation algorithm as claimed in claim 4, characterized in that the matrix J is defined by the following relation:

$$J = \left(1 \quad -M6\right)\begin{pmatrix} M1 & 0 \\ 0 & M5 \end{pmatrix}^{-1}\begin{pmatrix} M3 & 0 \\ 0 & M4 \end{pmatrix}\begin{pmatrix} M1 & M2 \\ {}^{t}M2 & 0 \end{pmatrix}^{-1}\begin{pmatrix} 1 \\ 0 \end{pmatrix}$$

where

$$M1_{ij} = \int_{A \in \Gamma} \bar{\varphi}_i(A) \cdot \bar{\varphi}_j(A) \, dS_A$$

$$M2_{ij} = \int_{A \in \Gamma} \psi_j(A) \, \text{div}_A(\bar{\varphi}_i) \, dS_A$$

$$M3_{ij} = \int_{A \in \Gamma} (\bar{\varphi}_j(A) \wedge \bar{z}(A)) \cdot \bar{\varphi}_i(A) \, dS_A$$

$$M4_{ij} = \int_{A \in \Gamma} \psi_j(A) \, \theta_i(A) \, dS_A$$

$$M5_{ij} = \int_{A \in \Gamma} \theta_j(A) \, \theta_i(A) \, dS_A$$

$$M6_{ij} = \left(\overline{\text{rot}}(\theta_j)\right)_{e_i}$$

where

$\bar{\varphi}_i$ is the usual basis of the Raviart-Thomas space;

θ_i is the basis of the trianglewise affine functions ;

ψ_i is the basis of the trianglewise constant functions ;

A a point belonging to the surface Γ of said body;

$\bar{z}(A)$ is a vector with unit norm, normal to the surface of said body at the point A, and oriented outward.

6. The electromagnetic simulation algorithm as claimed in one of the preceding claims, characterized in that the iterative algorithm used is a fast algorithm, of the multilevel multipole method type.

7. The electromagnetic simulation algorithm according to one of claims 1 to 5, characterized in that the iterative algorithm used is a fast algorithm, of the adaptive integral method method type.

8. The electromagnetic simulation algorithm as claimed in one of the preceding claims, characterized in that the body is an antenna for which one seeks to determine an optimal shape, by using the simulation algorithm in an antenna design tool.

9. The electromagnetic simulation algorithm as claimed in one of claims 1 to 7, characterized in that the body is an object of known shape for which one seeks to determine the radar cross section (RCS).